Appendix D

Table of Contents

List of Figures

APPENDIX D
HITCHHIKER GROUND DATA SYSTEM, FACILITIES, AND OPERATIONS

D1. HITCHHIKER GROUND SYSTEM OVERVIEW

The overall objective of the HH Ground System is to provide efficient service to a variety of customers and "transparent" interfaces such that the experiment-provided Customer Ground Support Equipment (CGSE) can be used for experiment design and development, as well as mission operations. To meet this objective, the HH Project requires the Mission Operations and Data Systems Directorate to provide standardized capabilities available to project organizations and the Engineering Directorate to provide specific HHC and customer data processing and CGSE interfaces via the Advanced Carrier Customer Equipment Support System (ACCESS).

Figure D.1 shows an overview of the HH ground system. The CGSE has the primary responsibility for providing the payload command and telemetry processing functions. Payload commands may also be executed from the ACCESS but this method is primarily used for contingency purposes only. The ACCESS provides the normal mode for commanding the HHC avionics. In addition, limited capability for commanding the HHC via an AFD switch panel is available to the crew. This capability is solely for activation and deactivation of the HHC and payload power, and for safing a payload in a contingency situation.

Commands initiated by the CGSE together with any commands from the ACCESS are transmitted from the HH Payload Operations Control Center (POCC) to the JSC MCC utilizing the NASA Communications (NASCOM) capabilities. Following execution of standard MCC command management functions, the commands are uplinked to the Orbiter and HHC via the White Sands Complex (WSC).

Command acknowledgment capabilities are available in the system. The MCC generates a Command Acceptance Pattern (CAP) and transmits it to the HH POCC and the Shuttle/POCC Interface Facility (SPIF). The SPIF processes the CAPs for auditing purposes and provides display information which is available to the operations personnel within the HH POCC. The CAP and HHC command monitor information can be made available to the CGSE as an option.

Telemetry received at the GSFC POCC via NASCOM includes the JSC composite data stream from the JSC MCC and the HHC medium rate composite data stream from the WSC. The JSC composite data stream includes the HHC low rate data stream downlinked via the Payload Data Interleaver (PDI), CAPS, and Calibrated Ancillary System (CAS) data.

Downlinked Shuttle systems telemetry, also called Shuttle ancillary data, is received at the JSC in counts, not engineering units. All parameters, called measurement stimulus identifiers -- MSIDs, are captured and calibrated into engineering units. These MSIDs are available to users via the CAS in realtime and via the Orbiter Data Reduction Complex (ODRC) non-realtime. The available MSIDs are transmitted to GSFC as CAS data.

The HHC low rate data stream is processed by the ACCESS to extract the HHC internal data stream and individual experiment data stream(s). The ACCESS extracts Orbiter CAS data for processing and forwarding to the individual experiment CGSE(s) and for recording. The ACCESS also demultiplexes the HHC medium rate composite data stream to extract the individual experiment data stream(s) and the HHC low rate data stream. The ACCESS processes the data following the mission to provide post mission data products for delivery to the customer.

The SPIF also receives the JSC composite data stream. This facility extracts and records various Orbiter information such as CAS data and formats it for display and hardcopy. These displays are made available to the operations personnel within the POCC via Closed Circuit Television (CCTV). The SPIF provides the Orbiter data to the Flight Dynamics Facility (FDF) as input for orbit and attitude display generation. In addition, the SPIF supports the JSC interface by providing several other services including data facsimile.

The FDF supports the HH and customer operations personnel by processing the Orbiter data obtained from the SPIF into a range of displays. These displays include alphanumeric information, world map plots and other graphical displays. The display information is available to the operations personnel within the POCC via CCTV. The FDF will, as an optional service, provide mission analysis for science operations.

ACCESS provides capability for remote workstations (usually at the JSC Customer Support Room (CSR)) via a TCP/IP connection.

Customer GSE in the POCC may connect to the Internet via a standard ethernet ten-Base-T connection for communication to a customer remote site or other Internet function.

In addition, the Project is developing a specification for connecting customer GSE to ACCESS via TCP/IP in place of or addition to the RS-232 connections. This will allow command and low speed data products to be communicated with a remote customer location via the Internet as well as CGSE in the POCC and allow remote preflight checkout of CGSE to ACCESS communications without the need for bringing customer equipment to GSFC. Customers interested in the TCP/IP option should contact the Project Office for details.

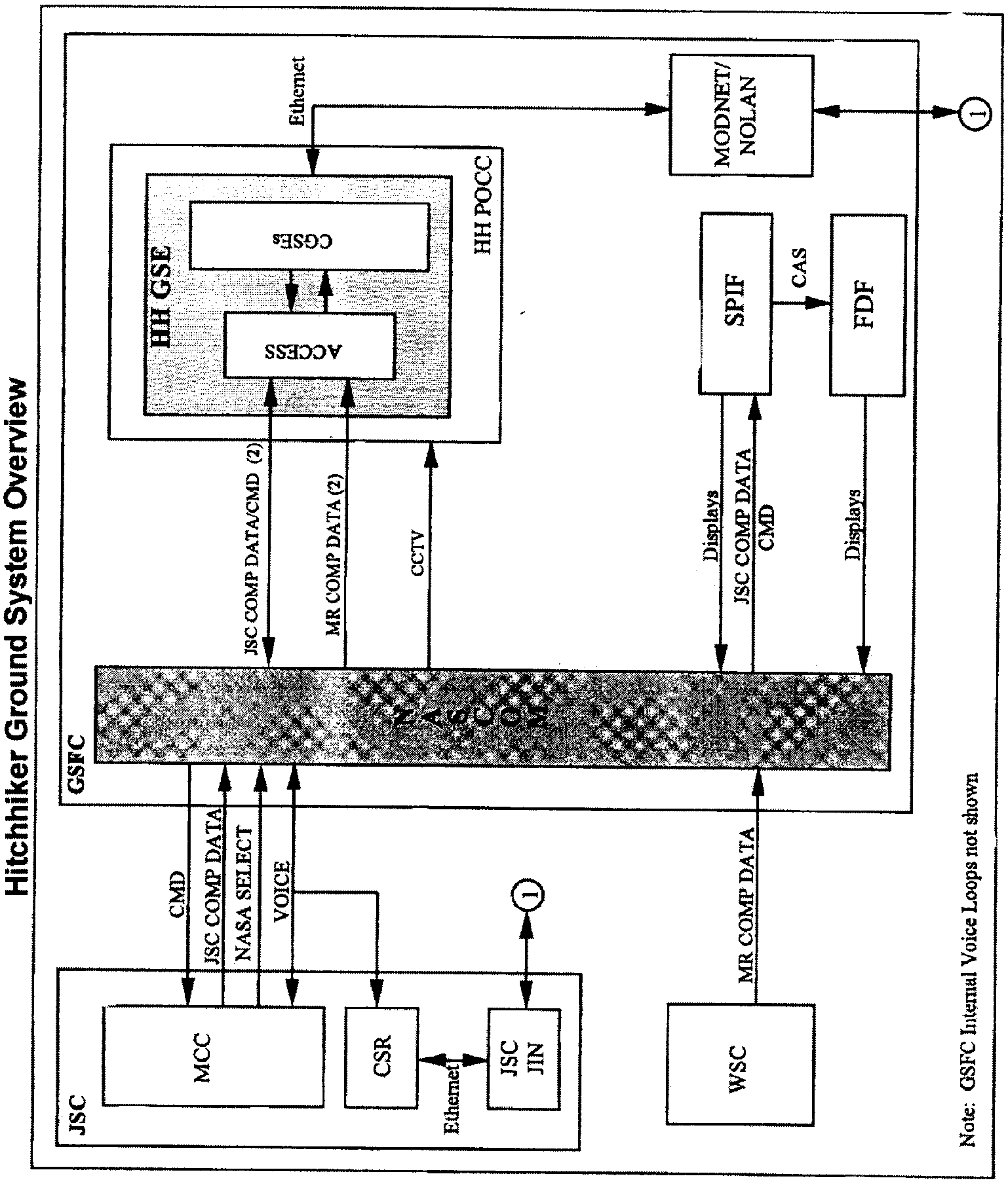

FIGURE D.1 HITCHHIKER GROUND SYSTEM OVERVIEW

D2. HITCHHIKER FLIGHT OPERATIONS TEAM (FOT) AND PAYLOAD OPERATIONS CONTROL CENTER (POCC)

Figure D.2 illustrates the HH POCC. The POCC is located in the Attached Shuttle Payload Center (ASPC) at the GSFC in Building 14, Room S287. The POCC is composed of a Mission Operations Area, an Experimenter Area, and a Common Area. The POCC Experimenter Area is approximately 800 square feet to accommodate experiment operators and equipment. Access to the control center is controlled with key cards. The POCC Experimenter Area will be provided with flexible and reconfigurable workstations for each experiment (four total).

The Experimenter Area will be provided with one 3'x7' (approximate) console per two operator positions for each experiment and at least 1 quad power outlet (110V AC at 15 A) for each operator position. One Voice Distribution System (VDS) key set for each operator position will be located in the Experiment Area. The VDS provides an interface to the voice communications network between the various NASA centers and also within the GSFC. Both black and white (b/w) and color CCTV displays with both b/w and color snap capability for every two operator positions will be located in the Experimenter Area. Two large screen color CCTV monitors, two UTC clocks, two MET clocks (with MET day), two countdown clocks, and four external telephone lines/units with data capability are situated in the Experimenter Area. Ten Base-T Network connections are also available in the experimenter areas.

Environmental conditioning in the POCC will maintain equipment temperatures at 21oC + 2oC, with a relative humidity of 50% + 10%.

The POCC Common Area of approximately 200 square feet accommodates a refrigerator, microwave, coffee machine, equipment storage area, xerox machine, and coat rack.

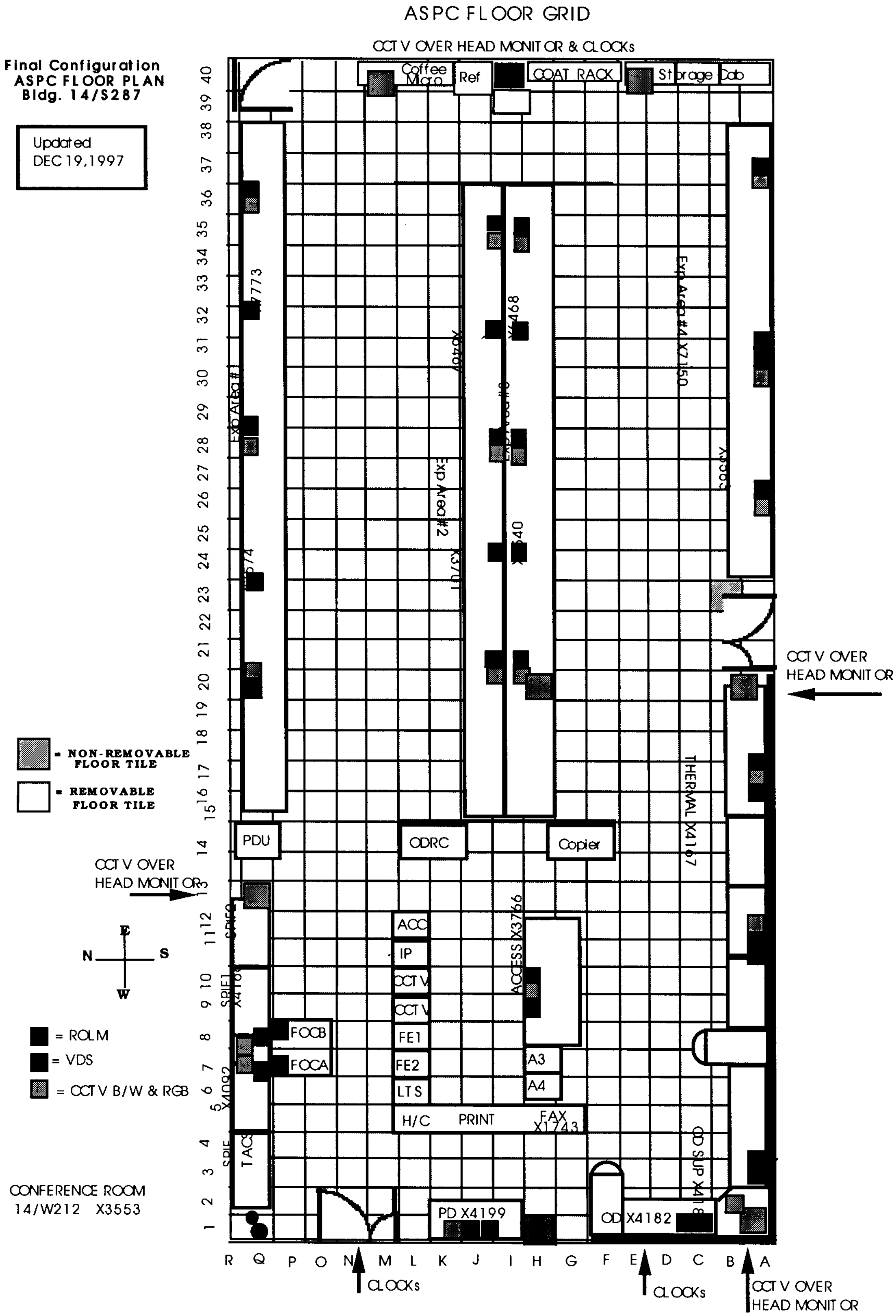

FIGURE D.2 ASOC FLOOR PLAN

D3. HITCHHIKER MISSION READINESS TESTING

A series of tests will be performed by the GSFC Mission Readiness Manager (MRM) in support of the HH customer to verify the readiness of ground facilities to support the HH mission. These tests will verify the functionality of the Ground Data System (GDS) with the payload and the JSC MCC. The HH customer will have completed all payload engineering tests prior to participation in HH mission readiness testing.

Three kinds of tests will be run:

1. Payload to GDS Interface Verification Test (IVT) (L-6 mos)
2. GDS Integration and Test (I&T) (L-6 mos to L-1 wk)
3. JSC IVT (L-4 mos to L-2 wks)

The Payload to GDS IVT will verify the ability of the CGSE (located in the HH POCC) to send commands to and receive telemetry from the payload. During these tests, telemetry from the payload will be recorded. These HH Payload Tapes will be used in future GSFC ground system tests and simulations in lieu of a real time payload telemetry stream. Some of the HH Payload MR Tapes will be forwarded by the MRM to the WSC to be used as the source of payload telemetry during those GDS I&Ts used to verify MR telemetry interfaces between the WSC and the GSFC. Some of the HH Payload LR Tapes will be forwarded by the MRM to the JSC Shuttle Avionics Integration Laboratory (SAIL) for the production of SAIL Tapes. SAIL Tapes will be the source of payload telemetry during the JSC IVT.

GDS I&T involving all of the elements of the HH ground system will verify the end-to-end capability of the operational GDS. The HH Payload Tapes will be the source of payload telemetry during the GDS I&T. Prior to the first Joint Integrated Simulation (JIS), CAS data will be provided through playback of past mission CAS Tapes. CAS Tapes recorded during the first JIS will be the CAS source during future tests. The GDS will be functionally verified within a week of a simulation.

JSC IVTs will verify command and LR telemetry interfaces between the JSC MCC and GSFC and will be performed at the same time that the payload is being integrated at the KSC. The payload telemetry will be provided through playback of the SAIL Tapes. JSC IVTs are normally scheduled immediately prior to each JIS.

Following the final GDS I&T (typically one week prior to the mission), the HH ground system will be completely verified and placed under configuration control by the MRM.

D4. HITCHHIKER OPERATIONS TRAINING

The HH Project and MRM will coordinate various training activities to ensure the operational readiness of the ground data systems and personnel supporting the HH mission. The HH Project will have completed all system tests prior to participation in simulations.

Three kinds of training shall be provided:

1. Classroom Training (L-2 yrs to L-3 mos)
2. Goddard Internal Simulations (GISs) (L-3 mos to L-2 wks)
3. Joint Integrated Simulations (JISs) (L-3 mos to L-2 wks)

A series of classroom training sessions will be held to familiarize customers with HH and Orbiter services, data systems configurations, and all aspects of mission operations. There are three sessions of training. Session #1 occurs at L-2 years, Session #2 occurs at L-6 months, and Session #3 occurs at L-3 months.

GISs will be conducted to exercise operational procedures and train operations personnel. During the GISs, the ground system will be configured using only GSFC facilities, requiring the participation of all elements of the GSFC complex involved in the mission. These simulations will test GSFC internal data, management, and operations interfaces. HH POCC procedures will be emphasized during these exercises.

The GISs will simulate selected portions of the planned mission timeline. The GDS will be configured to simulate normal operations as closely as possible.

JISs will be conducted to establish operability of the overall ground system including the links to the JSC MCC. During the JISs, the ground system will be configured as for mission operations. The JSC MCC will check commands, generate CAPs, and generate the composite data stream except for the HH PDI data. The HH payload telemetry will be simulated via playback of the HH Payload Tapes from the GSFC. The simulated CAS data sent from JSC will be recorded during the first JIS. This recorded CAS data will be played back during future tests and simulations.

JISs will be treated as an actual flight for the crew and all ground operations personnel and involve all facilities participating in the mission including the GSFC, the JSC MCC and other NASA centers and/or remote POCCs. The crew will participate from the Orbiter simulator at the JSC.

The JISs will simulate selected portions of the planned mission timeline. Coordination between the JSC MCC and the HH POCC will be emphasized during these exercises. These simulations will test data, management, and operations interfaces. Activities may require multiple-shifts coverage of multiple-day events.